PHYSICIAN KNOWLEDGE, PERCEPTIONS, AND ATTITUDES TOWARDS ELECTRONIC MEDICAL RECORD SYSTEMS IN NEWFOUNDLAND AND LABRADOR

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Physician Knowledge, Perceptions, and Attitudes towards Electronic Medical Record Systems in Newfoundland and Labrador

by

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Abstract

Objectives: To illustrate the knowledge, perceptions, and attitudes of Newfoundland and Labrador (NL) physicians towards electronic medical record (EMR) systems and their use in the practice of health care.

Methods: A self-administered mail-out survey was used to collect information on physician characteristics, computer experience, perceptions about EMR systems, and opinions on acceptable costs of these systems.

Results: Forty percent of eligible physicians responded. Physicians agreed that an EMR system should be implemented and that using an EMR would improve the access to and the efficiency of health care.

Conclusions: The major concern regarding the use and implementation of an EMR system is cost-related. Examining potential subsidy models for implementation and use of EMR systems for NL physicians should be undertaken.

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List of Abbreviations

EHR	Electronic Health Record
EMR	Electronic Medical Record
PHR	Patient Health Record
Infoway	Canadian Health Infoway
NL	Newfoundland and Labrador
NLCHI	Newfoundland and Labrador Centre for Health Information
NLMA	Newfoundland and Labrador Medical Association
NPS	National Physician Survey
OECD	Organisation for Economic Co-operation and Development
TAM	Technology Acceptance Model

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1.1 Research Problem

With the creation of Canada Health Infoway (Infoway), in 2001, Canada's health care system has been moving towards the creation of an electronic health record (EHR) (Boonstra & Broekhuis, 2010). Infoway is funded by the federal government and jointly invests with the provinces and territories to increase the development and adoption of EHR projects in Canada. It is believed that EHRs can improve on the current paper-based health care system by enabling an easy to read and accessible health record that integrates all aspects of an individual's care (Infoway, 2005, Shachak, Hadas-Dayagi, Ziv, & Reis, 2008). An important aspect of an EHR is the portion of the health record associated with physician care; this is called the electronic medical record (EMR).

An EMR system will enable physicians to send and receive information from the EHR in relation to their patients' health information, and thus be able to offer a more complete view of a patient's health condition. While Infoway states that almost 50% of Canadians will have access to core elements of an EHR system in mid-2011 (Infoway, 2001a), EMR adoption has been slow and, when implemented, generally under-used. As of March 2011, Infoway has reported an estimated that across Canada 49% of EHR system elements are available, these elements include but are not limited to EMR systems, diagnostic imaging, drug information systems, and registries (Infoway, 2011).

The province of Newfoundland and Labrador (NL), through the Newfoundland and Labrador Centre for Health Information (NLCHI) is moving forward with the goal of implementing an EHR for the province. NLCHI is attempting this implementation through the use and creation of many information technologies, including a unique personal identifier/client registry, diagnostic imaging/picture archiving and

communications systems, and projects in tele-health, pharmacy, and primary health care information systems. An evaluation of a pilot EMR system implementation in St. John's, NL (Neville, Caison, & Farrell, 2007) was completed by the eHealth Research Unit, Faculty of Medicine, Memorial University of Newfoundland.

The literature suggests that clinicians and staff are more likely to accept and continue to use an EMR system if, prior to implementation, expectations are clear and realistic and that physicians and other staff have the necessary skills to use the system.

1.2 Research Objectives

The purpose of this descriptive study is to examine physicians' attitudes towards EMR systems, in health care. Using a self-administered mail-out survey, the research objectives are:

1. To describe physicians' current use of and their training in the use of information technologies.
2. To describe physicians' knowledge of EMR systems and their perceptions of the effect of these systems on the practice of health care.
3. To describe physicians' perceptions of acceptable costs for the implementation and maintenance of EMR systems.

1.3 Rationale

The move towards the use of EMR systems represents a considerable investment of resources, not only funding for the implementation of these systems but also the time for physicians and other clinical staff to learn to use and incorporate EMR systems into their practice of health care (Shachak et al., 2008). For 2011, Infoway (2001b) has planned an investment of $380 million to assist with the implementation of EMR systems for Canadian physicians. Given the investment, it is important to examine the reasons for the slow uptake of EMR systems across Canada and how these barriers may be overcome.

The findings of this study will help with the planned implementation of an EMR system in the province of NL. The study will describe the current level of computer skills that physicians possess and their expectations and perceptions of EMR systems in their practice of health care. Study results will assist the Newfoundland and Labrador Medical Association (NLMA) and the provincial government to design an appropriate implementation process for the province and develop strategies to address physician concerns. It will also provide a baseline level of physicians' computer technology skills and knowledge for future evaluations of the effect of EMR system implementations in the province, as well as providing local evidence to be used in nation-wide comparisons of EMR implementation.

Chapter 2: Background and Literature Review

2.1 Background

The move towards the implementation and use of EMR systems is growing in the world. This growth is based on the many potential benefits of these systems, which have suggested an improvement in the quality of patient care and safety and addressing the barriers around implementation and use of these systems (Denomme, Terry, Brown, Thind, & Stewart, 2011; Garrido, Jamieson, Zhow, Wiesenthal, & Liang, 2005; Hillestad et al., 2005; Loomis, Ries, Saywell, & Thakker, 2002; Simon, Rundall, & Shortell, 2005). Uptake of these systems is thus very important.

In Canada, in 2007, approximately 9.8% of physicians relied solely on an EMR system in their practice (National Physician Survey [NPS], 2007), this number rose to 16.1% in 2010 (NPS, 2010). In comparison, Simon et al. (2005) stated that in the United States 20%-25% of physician organizations have adopted EMRs, while Johnston, Leung, Fung Kam Wong, and Ho (2002, p.42) cited rates of "90% in the UK, 84% in New Zealand, 70% in Denmark, 60% in Sweden and 40% in the Netherlands" and 30% of individual physician practises in Hong Kong. Ludwick, Manca, and Doucette (2010) found that EMR adoption in Canada (26%) and the United States (24-28%) was low for general practice physicians, and for all physicians when compared to other Organisation for Economic Co-operation and Development (OECD) countries (80% to 99%). While Canada is making progress on the implementation and use of EMR systems, it is not at the level needed to see the benefits that these systems can bring to patient health.

A clear message from the literature is that in order to improve EMR usage there needs to be greater understanding of the reasons for physicians' uptake (or lack thereof) to improve the usage of EMR systems (Aydin & Forsyth, 1997; Boonstra & Broekhuis, 2010; Gadd & Penrod, 2001; Joos, Chen, Jirjis, & Johnson, 2006; Rose, Schnipper, Park, Poon, Li, & Middleton, 2005). This improved understanding will help ensure successful adoption of EMRs by physician and other clinicians. Loomis et al. (2002, p.640) stated that the important differences between EMR users and non-users are: "(1) less perceived need for EMRs; (2) greater concerns about EMR data entry; (3) less confidence in the security and confidentiality of EMRs; and (4) more concerns about the cost for installation and ongoing use of EMRs."

2.2 Definitions

The use of information technology systems in health care has introduced a new set of terminology. These new health information terminologies include: electronic health record (EHR), personal health record (PHR) and electronic medical record (EMR), all of which tend to be used interchangeably although they have differences in their definitions. Hodge (2011) explains that a lot of the confusion between the three terms is due to the two ideas, the completeness of the information and the custodian of the health information. He provides the following definitions:

> **Electronic Medical Record** – a partial health record under the custodianship of a health care provider(s) that holds a portion of the relevant health information about a person over their lifetime. This is often described as a provider-centric or

health organization-centric health record of a person... We also have software products called Electronic Medical Records (EMRs). These EMR products are primarily used by physicians in their office or in an out-patient clinic. The term EMR has traditionally not been used to describe software products marketed at other points of healthcare service in Canada. (e.g. hospital, continuing care, public health, mental health and so on).

Electronic Health Record - a complete health record under the custodianship of a health care provider(s) that holds all relevant health information about a person over their lifetime. This is often described as a person-centric health record, which can used by many approved health care providers or health care organizations.

Personal Health Record – a complete or partial health record under the custodianship of a person(s) (e.g. a patient or family member) that holds all or a portion of the relevant health information about that person over their lifetime. This is also a person-centric health record. (Hodge, 2011, para. 8)

This survey used the definition created by The Institute of Medicine[1] and used by Simon et al (2005):

...electronically stored information about an individual's lifetime health status and health care. It replaces the paper medical record as the primary record of care, meeting all clinical, legal, and administrative requirements. An [EMR] system

[1] The Institute of Medicine is an American not-for-profit, government-independent organization whose purpose is to provide advice on issues related to biomedical science, medicine, and health.

provides reminders and alerts, linkages with knowledge sources for decision support, and data for outcomes research and improved management of health care delivery. (p. 631)

2.3 Technology Acceptance Model

The technology acceptance model (TAM), developed in the 1980s by Davis (Davis, 1986, as cited in Davis, Bagozzi, & Warshaw, 1989), is used for research into the use and acceptance of information systems (Chismar & Wiley-Patton, 2003; Hu, Chau, Liu Sheng, & Tam, 1999; Seeman & Gibson, 2009) with the aim of describing the factors associated with information technologies acceptance and intentions to use by individuals (Holden & Karsh, 2009; Malhotra & Galletta, 1999). The goal of TAM is "to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behaviour across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified" (Davis et al., 1989, p.985).

TAM was chosen for this study because of its widespread use in the literature. TAM has become a well-accepted model for assessing the implementation and use of information technology in the health care field (Holden & Karsh, 2009; Yarbrough & Smith, 2007). Holden and Karsh (2009) summarizes fifteen previous papers, which have used TAM to assess a health care technology; of these, ten focused on physicians as all or part of the study population. Yarbrough and Smith (2007) also summarizes eighteen studies on physician technology acceptance for a variety of technologies; of these, half

use the TAM as the model applied and have study populations consisting of physicians and residents. This model allows for the complexities of health care organizations and provides a starting point to address the problems around uptake of information technologies in health care.

Other models that could have been used to examine EMR use include, but are not limited to, the theory of reasoned action model, the theory of planned behaviour, TAM2, and the universal theory of acceptance and use of technology. These models have been compared and discussed in relation to TAM and each other in the literature (Chuttur, 2009; Holden & Karsh, 2009; Hu et al., 1999; Venkatesh, Morris, Davis, & Davis, 2003; Yarbrough & Smith, 2007). Additionaly, TAM was chosen because it is a general but information technology specific model which has been used in many different populations, and the physician population in specific. It has also been shown to be a good predictor of physician intention to use and accept technology, including EMRs.

TAM is illustrated in Figure 1. The aspects of the model that were used to organize the literature (shown in the dotted box) are perceived usefulness, perceived ease of use, attitude toward using and external variables. External variables influence users' ideas about using a system (perceived usefulness and ease of use). Perceived ease of use can influence perception of usefulness. Both sets of perceptions influence attitudes toward use, which is believed to influence behavioral intention to use, which in turn influence actual use; perceived usefulness can also influence behavioural intention to use (Burton-Jones & Hubona, 2003).

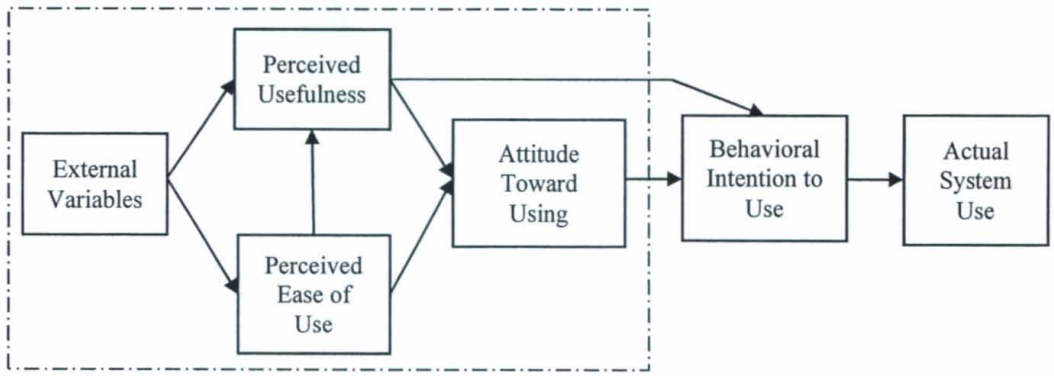

Figure 1: Technology Acceptance Model

Reprinted by permission, Davis, FD., Bagozzi, RP., & Warshaw, PR. User Acceptance of Computer Technology: A Comparison of Two Theoretical Models, Management Science, volume 35, number 8, August, 1989. Copyright 1989, the Institute for Operations Research and the Management Sciences, 7240 Parkway Drive, Suite 300, Hanover, Maryland 21076 USA.

** The dotted line illustrates the parts of the model used in this study.*

2.4 Perceived Usefulness

Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis et al., 1989, p. 985). This includes how physicians perceive EMR systems in general, their experiences with EMRs, and what physicians believe the benefits of an EMR would be.

The perceived benefits of the use of EMR systems have been well documented and mainly stem from the way computer systems store and structure patient chart information. EMRs have been shown to produce an improvement in the quality and continuity of patient care by allowing for complete and legible documentation, reducing medical errors and repetition of tests; improving access to patient records, evidence-based literature, and communication between physicians. Studies examining perceived usefulness employed a variety of methods including surveys (Loomis et al., 2002; Simon et al., 2005), qualitative

methods (i.e. focus groups and interviews) (Rose et al., 2005), evaluation of administrative databases (Clayton et al., 2005; Garrido et al., 2005), and literature reviews (OECD, 2010; Retchin, 1999).

2.5 Perceived Ease of Use

Perceived ease of use is defined by Davis et al. (1989, p. 985) as "the degree to which a person believes that using a particular system would be free from effort." Ease of use includes system design and usability, the ability of physicians to use the system and incorporate it into their workflow, and physicians' perceptions of the security of the EMR system and their control over the system and the data.

System design and usability are key concerns for potential users of EMR systems, including physicians. The main system concerns include the appropriateness and user-friendliness of software design (Brown, 2005; Clayton et al., 2005; Hodge, 2002; Johnston et al., 2002; Joos et al., 2006; Loomis et al., 2002; Retchin, 1999; Rose et al., 2005; Santiage, Li, Gagliano, Judge, Hamann, & Middleton, 2006; Teach & Shortliffe, 1981; Young, 1984) as well as the learning curve and the training required to use the system (Gamm, Barsukiewiczm, Dansky, & Vasey, 1998; Hodge, 2002; Johnston et al., 2002; Gadd & Penrod, 2001; Joos et al., 2006; Kaelber, Greco, & Cebul, 2005; Ludwick et al., 2010; Santiage et al., 2006; Teach & Shortliffe, 1981; Terry, Giles, Brown, Thind, & Stewart, 2009; Young, 1984). Other system concerns revolve around security and confidentiality of information held in these EMR systems (Boonstra & Broekhuis, 2010; Clayton et al., 2005; Johnston et al., 2002; Joos et al., 2006; Loomis et al., 2002; Retchin,

1999; Terry et al., 2009) and the lack of technical standards for EMR systems (Clayton et al., 2005; Ludwick et al., 2010; OECD, 2010; Retchin, 1999; Young, 1984).

Design concern links into physicians' concerns over interaction with their patients, being comfortable using the system during encounters and their own level of keyboarding and computer skills (Boonstra and Broekhuis, 2010; Cork, Detmer, & Friedman, 1998; Johnston et al., 2002; Joos et al., 2006; Loomis et al., 2002; Simon et al., 2005; Terry et al., 2009). Design issues lead into concerns over the EMR systems' potential for change to physicians' current work processes (Boonstra & Broekhuis, 2010; Brown, 2005; Gadd & Penrod, 2001; Greiver, Barnsley, Glazier, Moineddin, & Harvey, 2011; Johnston et al., 2002; Ludwick et al., 2010; Rose et al., 2005; Terry et al., 2009; Young, 1984); and also potential changes in the interaction between physicians and patients with the introduction of a computer during the encounter (Gadd & Penrod, 2001; Johnston et al., 2002; Ludwick et al., 2010; Simon et al., 2005). Sittig, Fuperman, and Fiskio (1999) state that it is important for system designers to take into account how physicians will be using the system. Brown (2005) emphasizes this by suggesting that physician reluctance to use the system is often a result of the system being overly designed, thus making the system less intuitive to use than a paper record. Additionally, physician concern about how paper records will be converted to an electronic format and how notes will be entered (Payne, tenBroek, Fletcher, & Labuguen, 2011) have been identified as a potential barriers to EMR use (Chisolm, Purnell, Cohen, & McAlearney, 2010; Clayton et al., 2005; Loomis et al., 2002).

As Rose et al. (2005) and Aydin and Forsyth (1997) have both stated, for EMR systems to be of use to physicians, physicians must be comfortable with the system and confident in their ability to use the system to perform their jobs. Health technology must be user friendly and meet standards and technological requirements for systems to be adopted and used. Physician acceptance is not only closely linked to system design and usability, but also to the physician's comfort level in using computers. Laerum, Ellingsen, and Faxvagg, 2001 (2001) stated that computer literacy and changes to work-flow were possible reasons for the lack of EMR usage.

2.6 Attitude Toward Using

Attitude toward using, as Davis et al. (1989) defines it, is affected by both perceived usefulness and perceived ease of use. In addition, attitude toward using incorporates the input of the user into the selection or creation of the system and the feeling of "voluntariness" the user experiences in choosing, implementing, and using an EMR (Clayton et al., 2005; Joos et al., 2006; Loomis et al., 2002; Young 1984). Attitude toward using is alsoaffected by concerns of ownership and security and any "Big Brother" control of the system (Loomis et al., 2002; Simon et al., 2005) and belief in the evidence of the benefits of EMR use (Loomis et al., 2002; Teach & Shortliffe, 1981; Yarbrough & Smith, 2007).

Physician resistance toward using an EMR is a commonly expressed barrier to EMR system implementation (Boonstra & Broekhuis, 2010; Gadd & Penrod, 2001; Johnston et al., 2002; Joos et al., 2006; Simon et al., 2005; Young, 1984). Physician attitudes play a

vital role for acceptance of computer systems; physician work process and their attitudes towards information technologies are shown to be important constraints (Young, 1984). Aydin and Forsyth (1997) and Cork et al. (1998) both state that much research has examined physicians' attitudes towards computer systems. Teach and Shortliffe (1981, p.542) expressed it best when saying, "despite the promise of medical computing innovations, many health care professionals have expressed scepticism about the role of the computer as an aid to clinicians". To counter this resistance, research has shown that having strong leadership or a 'champion' for the implementation of the system can positively affect the adoption of EMR (Hing, Curt, & Woodwell, 2007; Ludwick et al., 2010; Terry et al., 2009).

2.7 External Variables

External variables are those that influence users' perceptions (see sections 2.4 and 2.5) about the system, including things such as practice size, system costs, and system and user issues, as previously discussed in perceived usefulness and ease of use sections.

Practice size has been shown to be a factor in the implementation and adoption of EMR systems (Hing et al., 2007; Miller, Hilllman, & Given, 2004; Retchin, 1999; Simon et al., 2005). There has been a lack of research into the adoption of EMR systems in small clinics, with most research being conducted on hospital implementations or clinics associated with hospitals (Keshavjee, Troyan, Holbrook, & VanderMolen, 2001). Simon et al. (2005) found that larger groups would be more likely than small clinics to adopt EMR systems. The reasons for this could be the associated costs of EMR systems and the

perceived difficulties of adoption of EMR systems into current practice workflow and workloads.

System costs have been identified as a potential barrier to the adoption and use of EMR systems, with the cost of systems including software, hardware, support and maintenance, training of physicians and staff, and initial productivity loss (Boonstra et al., 2010; Johnston et al., 2002; Loomis et al., 2002; Ludwick et al., 2010; Retchin, 1999; Simon et al., 2005; Terry et al., 2009; Wang et al., 2003). The literature estimates that the cost of EMR systems (in US $) range from $1,600 to $10,000 per physician for software costs alone, based on US systems and studies (Brown, 2005; Wang et al., 2003). Littlejohns, Wyatt, & Garvican (2003) estimated the cost of an EMR to be approximately $50 million for large hospital. Greiver et al. (2011) and Terry, Chevendra, Thind, Stewart, Marshall, & Cejic (2010) also have found an increase in uptake based on reimbursement or subsidies. There is also evidence that EMR systems will eventually produce economic benefits that after a few years of use would offset the initial cost of setup (Brotzman, Guse, Fay, Schellhase, & Marbella, 2009; Wang et al., 2003).

2.8 Previous Surveys

A number of researchers have previously surveyed physicians to examine facilitators and barriers to EMR use. Loomis et al. (2002) completed a cross-sectional mail out survey of family physicians to determine any differences in attitudes, beliefs, and demographic characteristics between EMR users and non-users. Loomis et al. (2002) found that there was a difference in attitudes and perceptions of users and non-users of

EMR systems. He found that non-users perceived less need for EMRs, had more concerns about data entry, had less confidence in the systems security and were more concerned about associated costs than users.

Simon et al. (2005) collected data on characteristics of medical groups, including years of practice, size of practice, information technology use, and external incentives. These data were collected through structured interviews. Simon et al. (2005) found that knowing organizational characteristics could help with the adoption of EMR systems, for example that financial incentives would benefit all medical groups, but especially smaller groups.

To evaluate physicians' attitudes towards computer-based clinical decision aids Cork et al. (1998) developed a questionnaire. This survey instrument was designed to include measures of computer use not included in most prior studies, and to specifically address the roles and activities of physicians. Cork et al. (1998) found that computer use and knowledge was related to respondents' training and self-reported skill level.

Laerum and colleagues (Laerum et al., 2001; Laerum & Faxvagg, 2004) created and used questionnaires to investigate and compare the use of EMR systems in a hospital setting and a task-oriented evaluation. General tasks related to physician work were assessed along with computer literacy and user satisfaction, both surveys were validated. Laerum et al. (2001) found that in general physicians use EMR systems for less tasks than they could be used for. Laeurm and Faxvagg (2004) found that the tested questionnaire provides reliable results with respect to clinical work and EMR systems.

Other studies have focused on specific sections on the topics that the studies mentioned above have covered. Krall (1995) and Miller et al. (2004) have linked

physicians' current computer usage to their acceptance and use of EMRs. Attitudes and perceived effects have been linked to acceptance and use of EMR systems in previous studies (Al Farsi & West, 2006; Ford, Menachemi, & Phillips, 2006; Gadd & Penrod, 2001; Littlejohns et al., 2003; Musham, Ornstein, & Jenkins, 1995). Specific demographic variables, such as age and practice size, have been linked to acceptance and usage of EMR systems in practice ("Physician use of EMRs", 2005; Ford et al., 2006; Miller, West, Brown, Sim, & Ganchoff, 2005; Simon et al., 2005).

The knowledge base of information technology use and acceptance surrounding health professionals, specifically physicians, is ever growing and allows for a more thorough and comprehensive implementation plan. To date, this information has not been collected from physicians in NL despite the plans to adopt EMRs into the health care systems.

Chapter 3: Methods

3.1 Study Design

This descriptive study explores physicians' attitudes and perceptions of EMR systems. A self-administered survey (Appendix A) was used to collect information about physicians' current computer skills and training and their perceptions and knowledge of EMR systems and their effect on the practice of health care. Physicians were surveyed between September 2007 and December 2007.

3.2 Study Population

The study population included all general practitioners/family physicians and specialists registered with the College of Physicians and Surgeons of NL as of July 31, 2007, including administrative and teaching physicians for a total of 1083 physicians.

3.2.1 Eligibility

To be eligible to participate in the study, physicians must be registered with the Royal College of Physicians and Surgeons of Newfoundland and Labrador as of July 31, 2007 and not be a participant in the Pilot EMR Implementation Evaluation Study being conducted by the eHealth Research Unit (physicians at the Newfoundland Drive Family Practice, Family Practice Unit at the Health Sciences Centre, including the Shea Heights site).

Also excluded from the survey were residents and trainees, and those who returned surveys which did not have the demographic information or the majority of the EMR

knowledge and usage questions completed. Additionally, physicians with an address outside of NL, those who were identified as no longer practicing in the province, and those identified as no longer working at the listed address were also excluded.

3.2.2 Representativeness of the Sample

To assess the representativeness of the sample, χ^2 tests were used to compare gender and speciality, for the sample population to the total population of physicians in NL. Physician population characteristics were available from the 2007 National Physician Survey: NL Demographics (NPS, 2007). These data were used as it is representative of the study population at the time this study was conducted.

3.3 Survey Development

The most common method found in the literature for studying physician acceptance and use of EMR systems was through the use of surveys (Cork et al., 1998; Laerum et al., 2001; Loomis et al., 2002; Simon et al., 2005). The questionnaire used in this study was developed by selecting questions from other validated survey instruments (Cork et al., 1998; Laerum et al., 2001; Laerum & Faxvagg, 2004; Loomis et al., 2002) (see section 2.8). In some cases, questions were modified and new questions were developed to address the study objectives. Appendix B describes the specific questions used to develop the survey used in this study.

The questionnaire was divided into three sections: current usage of computers, physician perceptions and attitudes towards EMR systems and their effects on health care, and demographics. These sections and their related survey questions are described below.

The first section of the survey contained questions around physicians' current computer usage. Questions included the ownership and use of computers at home and work, the use of computers for specific tasks in their practice, previous computer training, and self-reported ranking of computer skills. These questions were based on questions from studies by Cork et al. (1998), Laerum et al. (2001, 2004) and Loomis et al. (2002).

The second section of the survey contained questions related to knowledge and use of EMR systems and was based on questions from Cork et al. (1998), Laerum et al. (2001, 2004), Loomis et al. (2002), and Kaelber et al. (2005). Questions addressed physicians' general thoughts towards EMR systems, their usage in the practice of health care and the cost of implementation and upkeep of an EMR system. Five-point Likert scales were used to measure physician attitudes about EMR systems (where 1 was strongly disagree and 5 was strongly agree) and their usage and their effect on the practice of health care (where 1 was highly detrimental and 5 was highly beneficial). This section also contained newly created questions to evaluate the opinions around government subsidy of EMR costs.

The final section of the survey collected demographic data. Items included: age, gender, practice size, community size, the number of years in practice, and area of specialty. Questions for this section came from Cork et al. (1998), Kaelber et al. (2005), Laerum et al. (2001), Simon et al. (2005) and Loomis et al. (2002). Age and community size categories used are the categories used in the original survey they were taken from,

and age categories are the same as those used in the Neville et al. (2007) study. This section also contained three open-ended questions allowing physicians to express any other thoughts about EMRs, their use in practice and comments on this study.

3.3.1 Pretesting

The survey was pre-tested by three local experts in medical technologies and research methods. As a result of the pre-test, questions were modified to more specifically address the creation of a baseline of NL physicians' computer skills and EMR knowledge. During the pre-test, it was determined that the survey could be completed in ten minutes. On the advice of this expert panel, a pilot test was not conducted.

3.4 Data Collection

Mailing addresses were obtained from the College of Physicians and Surgeons of NL. Each physician was sent a package containing the questionnaire, postage-paid pre-addressed return envelope, and a letter explaining the purpose of the study. The letter was signed by Dr. G. Farrell, Director of the eHealth Research Unit, Memorial University and by the study investigator. The letter informed physicians of the purpose of the study (Appendix C).

The NLMA supported this project (Appendix D). The Association included information about the study on its website and a notice was emailed out to physicians, excluding those who opted out of this method of communication, prior to the surveys

being mailed out. These communications raised awareness of the study, assured physicians the study was credible and provided a brief overview of the study.

The survey was first mailed out in September, 2007, with a second package sent to non-respondents three weeks later in October, 2007. The information letter (Appendix C) used in the second package was modified from the original letter to contain thank you to anyone who had previously completed the survey and were receiving a follow-up in error.

Non-respondents were identified by an unique number assigned to each physician and printed on each survey. This identification number was assigned to each physician who was eligible for the study by staff at the Health Research Unit, Division of Community Health, Faculty of Medicine. Health Research Unit staff used the identification numbers to track respondents and non-respondents.

Survey results were kept separate from the file containing the physician contact information (name and mailing address). The use of an assigned identification number and the separate files ensured that individual physician survey responses were not identified by the investigator.

3.5 Data Management

Survey responses were directly entered into SPSS for Windows, version 17.0; where appropriate data were coded/recoded. Before analysis, the data were cleaned to identify and remove any data entry errors. The results to the open-ended questions were coded into themes; each theme was assigned a numeric code and then entered into the SPSS file. Missing data were coded at the data entry stage.

3.5.1 Data Quality

Initial counts were conducted to assess the amount of missing data. One percent of the data were missing for the majority of the questions (ranging from 0.2% to 15.9%). The questions regarding cost of EMRs ("I believe that an affordable price per physician to set up an EMR system is..." and "I am willing to spend the following amount monthly for ongoing use of an EMR...") had the highest amount of missing data at 11.5% and 15.9% respectively. Appendix E provides details on the number of missing (including don't know) for specific questions.

Ten percent of surveys were re-entered to calculate data entry errors rates. To complete the data re-entry, identification numbers for respondents were entered into excel, randomized, and then the first ten percent (forty) were re-entered into SPSS with the number of discrepancies were counted. In 2,680 variables there were three errors giving an error rate of 0.11%.

Data were coded during entry; Appendix F shows the coding scheme for the survey. Data were coded as invalid if an appropriate category could not be assigned in consultation with local experts (Dr. G. Farrell[2], Dr. D. Neville[3], and Dr. V. Gadag[4], Personal Communication, January 21, 2008), the percentage of invalid coding ranged from 0.2% to 1.0%. Additional coding/cleaning of the data were conducted when multiple responses were provided to questions asking for only one response, in these

[2] Dr. Farrell: Director of the eHealth Research Unit, Faculty of Medicine, Memorial University of Newfoundland; practicing physician; EMR advocate

[3] Dr. Neville: Administrative Lead of the eHealth Research Unit, Faculty of Medicine, Memorial University of Newfoundland; Associate Professor of Health Care Policy and Delivery, Division of Community Health and Humanities , Faculty of Medicine, Memorial University of Newfoundland

[4] Dr. Gadag: Professor of Biostatistics, Division of Community Health and Humanities, Faculty of Medicine, Memorial University of Newfoundland

cases the data was coded based on the recommendations of local experts in the field (Dr. G. Farrell, Dr. D. Neville and Dr. V. Gaddag, Personal Communication, January 21, 2008) and are shown in Appendix G. In addition, errors were also identified using frequencies and cross-tabulations to identify incorrect or implausible errors. When errors were identified, the original survey was consulted.

For the question to identify respondents' area of speciality the original categories were: anaesthesiology, cardiology, critical care, emergency medicine, endocrinology, family medicine, gastroenterology, general internal medicine, infectious disease, laboratory medicine, nephrology, neurology, obstetrics/gynaecology, oncology, ophthalmology, orthopaedics, paediatrics, psychiatry, radiology, rheumatology, surgery, urology, and other. The responses to this question were condensed to two categories "family physician" and "specialist/other". On the recommendation of a local expert (Dr. G. Farrell, Personal Communication, January 21, 2008) those who selected "family medicine" or wrote "general practice" in the other field were coded as "family physician" and those who either identified as anything outside of these were coded as "specialist/other".

3.6 Data Analysis

The statistics program SPSS, version 17.0, was used to analyze the data. Given the research objectives, the analyses were largely limited to descriptive statistics (frequencies for categorical data and means and standard deviations for ordinal data). The results to the open-ended questions were presented as frequencies, based on the assigned themes.

Missing, invalid and "don't know" responses were excluded from the analyses outside of frequency counts. χ^2 tests were used to assess the representativeness of the sample (see section 3.2.2).

Prior to the analyses, responses to the two Likert scale questions were examined to assess the distribution of the responses. Using histograms as well as kurtosis and skew values for each item, it was determined that the items were normally distributed (excluding the "don't know" responses). Therefore, these items were analysed as ordinal variables, and means and standard deviations were used (Norman & Streiner, 2008).

3.7 Ethical Considerations

This study was approved by the Human Investigation Committee of Memorial University (Appendix H). All data were stored on a password-protected computer and all completed surveys were stored in a secure room. Results are presented in aggregate form only, to protect confidentiality.

Chapter 4: Results

4.1 Survey Response

There were 1083 physicians listed with the Royal College of Physicians and Surgeons of Newfoundland and Labrador as of August 2007. Twenty-nine physicians were excluded since they were participating in a pilot EMR Implementation study being conducted by the eHealth Research Unit. Forty-five were excluded due to issues with their address, i.e. none provided or out of province. Of the remaining 1009 physicians, 409 returned a completed survey, giving a response rate of 40.5% (see Figure 2).

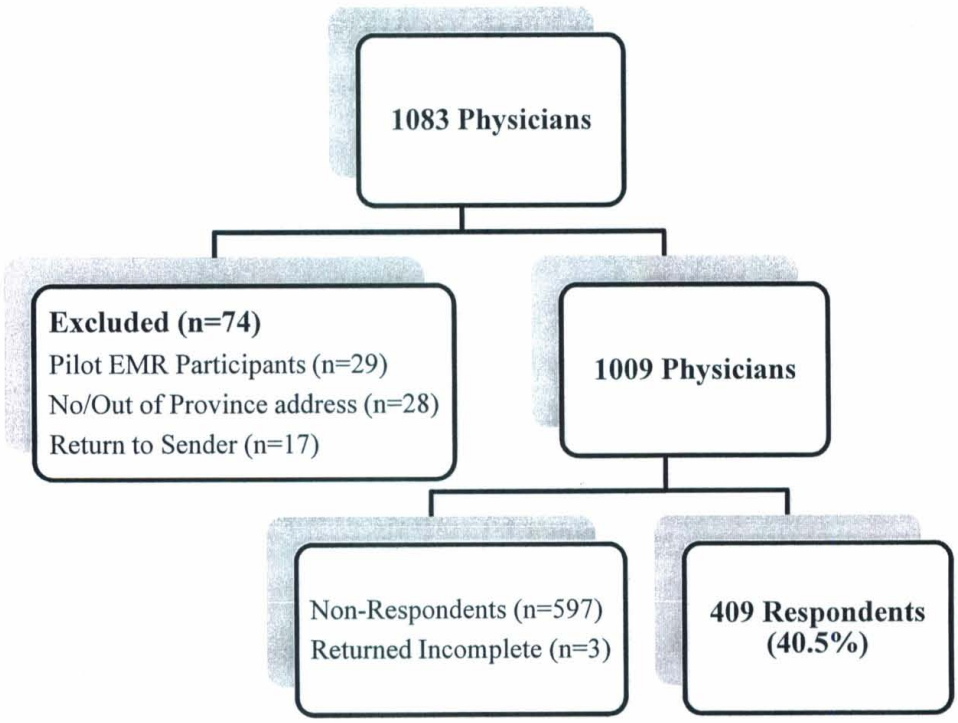

Figure 2: Study sample and response rate

4.2 Representativeness

The study respondents are representative of the complete physician population of NL for gender, but not when broken out by specialty. The study sample under represented the proportion of family physicians, while over representing the proportion of specialists (Table 1).

Table 1: Comparison of physicians and sample frame to assess representativeness of the study sample

	Respondents	NPS NL 2007	P-value for χ^2 test
Gender			
Male	274 (67.8%)	734 (70.6%)	>0.05
Female	130 (32.2%)	305 (29.4%)	
Speciality			
Family Physicians	194 (48.6%)	654 (62.9%)	<0.05
Specialist/Other	205 (51.4%)	385 (37.1%)	

NPS = National Physician Survey, NL= Newfoundland and Labrador

4.3 Respondent Characteristics

Table 2 describes respondent characteristics. The majority of respondents were male (67.8%). Half of the respondents were in the age category of 35-50 years of age. There was an almost even split in the number of family physicians (48.6%) and specialist/other (51.4%). The majority of respondents practiced in a community with a population greater than 10,000 (73.8%) and worked in a small group practice (40.7%). Years of practice ranged from 1 to 59 years, with a mean of 20 years.

Table 2: Characteristics of physicians in the study

Variable	n (%)*
Age Category	
<35 years of age	49 (12.0)
35-50 years of age	207 (50.7)
>50 years of age	152 (37.3)
Gender	
Male	274 (67.8)
Female	130 (32.2)
Speciality	
Family Physicians	194 (48.6)
Specialist/Other	205 (51.4)
Work Setting	
Solo practice	81 (20.9)
Small group	158 (40.7)
Large group	36 (9.3)
Hospital	92 (23.7)
Other	21 (5.4)
Community Size	
<1,000 people	6 (1.5)
1,000-4,999 people	40 (9.9)
5,000-10,000 people	60 (14.8)
>10,000 people	299 (73.8)
Years of Practice (years)	
Range	1-59
Mean (sd)	20.0 (11.2)
Median	20.0

*Except for Years of Practice; Variables may add up to less than 409 due to missing data

4.4 Respondent Current Computer Usage

Table 3 describes respondents' current computer ownership and training. The majority (54.0%) report having average computer skills. A larger proportion of physicians obtained these skills through self-guided learning (67.2%) versus a more formal method of learning (20.5%). "Other" sources of training were provided informally and included family and friends.

The majority of physicians reported having a desktop computer at home (81.2%) and at work (83.9%); among these physicians, 82.2% and 77.3% respectively actually use these computers. Slightly more than seventy percent (72.1%) of physicians responded that they had a laptop computer and of these 79.3% used their laptop. Of the 42.5% who said they owned a personal digital assistant[5], 72% indicated they used it.

Table 4 illustrates some of the common uses of computers by the physicians in their workplace. The majority of physicians responded that they always used a computer to obtain the results of tests (53.1%), that they sometimes used computers to obtain advice on a diagnosis/therapy (55.2%) and that they never used a computer to write sick notes (74.4%), order tests (60.8%), refer patients (68.1%) or write prescriptions (82.1%). Other uses of a computer in the physicians' workplace included: billing, communicating with patients and their families, and scheduling. The last column of this table, "I don't perform this task", allows us to separate those physicians who do not use computers for the assigned task and those whose speciality does not require them to perform the listed task.

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[5] Personal digital assistant does not include smart phones (such as iPhones or android phones) or tablets as this technology was not available at the time of this study.

Table 3: Computer characteristics of physicians in the study

Variable	n (%)
Self-reported skill level	
Very unsophisticated	27 (6.7)
Unsophisticated	83 (20.6)
Average	217 (54.0)
Sophisticated	62 (15.4)
Very sophisticated	13 (3.2)
Method of computer training*	
No Training	39 (7.6)
Self-guided learning about computers	347 (67.2)
Formal workshops/conferences on computers (no CMA credit)	30 (5.8)
Formal workshops/conferences on computers (CMA credit)	8 (1.5)
Formal medical school training in computers	14 (2.7)
Formal course(s) in computer science or related field	54 (10.5)
Other	24 (4.7)
Have a...	
Desktop computer at home	332 (81.2)
Desktop computer at work	343 (83.9)
Laptop computer	295 (72.1)
Personal Digital Assistant	174 (42.5)
Use a ... *(of those who have this technology)*	
Desktop computer at home	273 (82.2)
Desktop computer at work	265 (77.3)
Laptop computer	234 (79.3)
Personal Digital Assistant	126 (72.0)

CMA = Canadian Medical Association; Variables may add up to less than 409 due to missing data; *Variables may add up to more than 409 due to multiple responses per-physician.

Table 4: Frequency of computer use to perform tasks in practice among physicians in NL

Task	Never n(%)	Sometimes n(%)	Always n(%)	I don't perform this task n(%)
Review patient history/record	101 (24.9)	117 (28.8)	173 (42.6)	15 (3.7)
Communicate with colleagues	101 (25.0)	187 (46.3)	105 (26.0)	11 (2.7)
Write sick notes	296 (74.4)	21 (5.3)	22 (5.5)	59 (14.8)
Obtain advice on a specific patient's diagnosis/therapy	107 (26.6)	222 (55.2)	55 (13.7)	18 (4.5)
Obtain the results of a patients test/procedure	43 (10.7)	137 (34.0)	214 (53.1)	9 (2.2)
Order x-ray, ultrasound or CT investigations	244 (60.8)	41 (10.2)	54 (13.5)	62 (15.5)
Refer the patient to other departments/specialists	271 (68.1)	54 (13.6)	27 (6.8)	46 (11.6)
Write prescriptions	325 (82.1)	16 (4.0)	12 (3.0)	43 (10.9)

Variables may add up to less than 409 due to missing data

4.5 EMR Knowledge and Use

EMR perceived knowledge and use for physicians in NL are shown in Table 5. The majority (80.1%) of the respondents "agree" or "strongly agree" with the definition of an EMR system provided (see section 2.2).

An open-ended question was provided for respondents to express their reasons for agreeing or disagreeing with the given definition and 27.4% of physicians provided some explanation. Of these physicians, 65.2% were in agreement with the definition. These physicians felt an EMR system would reduce medical errors, increase and ensure the lifespan, accuracy, and legibility of the patient chart. One physician summed it up with the following statement, "I believe it is simply pathetic that Medicine, as a discipline, is not taking advantage of computers. A similar situation in other sciences would be embarrassing".

Those who were unsure about the definition (16.1%) or did not indicate a level of agreement with the definition (2.6%) stated ignorance about these types of systems or suggested that the system must be used in order for it to work. Other reasons provided focused on being unsure about different elements of the given definition and the perceived implication of an improvement in health care from the use of these systems. Also, concerns about the possibility of power outages and computer failure and the need to enter all the current patient information were cited.

Those who disagreed with the definition (16.1%) stated concerns centered around the broadness of the definition, the use of the word "replace" and the issues that they felt this caused, and the feelings that "paper has been used for years and works well" and that the

EMR would make health care more difficult to deliver, "we should be treating patients not computers".

When asked if they had ever used an EMR system 46.0% of physicians stated that they had used an EMR before. It was noted here that some physicians looked at the MediTech system as an EMR, while others did not. The MediTech system is an EHR; it is an information system used in health care facilities (i.e. hospitals) to document and track patient history and care in a comprehensive and integrated manner. The definition of EMR systems used in this survey was broad enough to that participants could include the MediTech system as an EMR system.

Respondents were also provided with open-ended questions to express what they felt were the biggest advantages and the biggest barriers to using an EMR system. The responses were coded into major themes (Table 5). The most common advantage given was access to patient information and the efficiency this provided for care; the most common barrier given was technology challenges, such as use of the EMR system, moving paper records to an electronic version, and general discomfort with using a computer.

At the end of the survey, respondents were provided with space to add their additional comments about EMRs in general and on the movement towards using these systems, coded results are found in Table 6 and Table 7 respectively. Of the 409 physicians who responded to the survey, 185 (45.2%) supplied a response when asked about any comments they had on EMRs in general, and 174 responded (42.5%) with a comment when asked about the movement towards the use of EMRs in clinical practice.

Table 5: EMR perceived knowledge and use for physicians in NL

Variable	n (%)
Agreement with EMR Definition	
Strongly disagree	20 (5.0)
Disagree	12 (3.0)
Unsure	48 (11.9)
Agree	237 (58.8)
Strongly agree	86 (21.3)
Have used an EMR system	
No	218 (54.0)
Yes	186 (46.0)
Biggest advantage of an EMR system*	
Access and efficiency	287 (72.5)
Improved health care	64 (16.2)
Paperless	33(8.3)
Cost savings	9 (2.3)
Research	3 (0.7)
Biggest barrier related to EMR systems*	
Technology challenges	173 (34.0)
Program and change management	121 (23.8)
Funding and human resources	115 (22.6)
Data concerns	96 (18.8)
Other	4 (0.8)

EMR = Electronic Medical Record; *Variables may add up to more than 409 due to multiple responses per-physician; Categories based on coding of open-ended questions

As Table 6 shows general comments were primarily positive in nature (43.8%), other comments were coded into four specific categories: EMR system concerns (including topics of system design and compatibility, standards and security), change management concerns (including topics related the training of physicians and staff to use the system and the process to transfer paper records into the EMR), monetary concerns (including topics such as funding and system cost) and miscellaneous (this included mainly comments about the need for NL to catch up to other countries and Canada in EMR use).

Table 6: Physician opinions regarding EMR systems in general

Comments on EMRs in general	n (%)
EMR system concerns	33 (14.0)
Change management concerns	27 (11.5)
Monetary concerns	30 (12.8)
General comment – positive	103 (43.8)
General comment – negative	24 (10.2)
Miscellaneous	18 (7.7)

EMR = Electronic Medical Record; Categories based on coding of open-ended questions; Multiple responses per-physician

Table 7 shows the coding of the responses to the open-ended question asking about the movement towards using EMR systems in clinical practice, 74.1% of those that responded with a comment positive in nature. Of those who provided positive comments the majority were coded as miscellaneous (59.2%), these comments generally noted that EMRs were essential for practice, that we needed to move ahead with their implementation and that current progress was too slow. Of those who provided a negative comment, the majority were coded as miscellaneous (47.5%). These centered on a

variety of topics ranging from the type of facility a physician worked in, to the level of government control, and the stage of the physicians career. Other comments of interest from across all levels of comments were focused on the need for consultations with physicians during the entirety of the implementation process, technical support and government subsidy.

Table 7: Physician opinions regarding the movement towards using EMR systems in clinical practice

Variable	n (%)
Classification of Comment	
Negative comment	36 (20.7)
Neutral comment	9 (5.2)
Positive comment	129 (74.1)
Positive Comments Coding	
System	26 (19.0)
Monetary	15 (10.9)
Change management	15 (10.9)
Miscellaneous	81 (59.2)
Neutral Comments Coding	
System	2 (18.1)
Monetary	3 (27.3)
Change management	3 (27.3)
Miscellaneous	3 (27.3)
Negative Comments Coding	
System	2 (5.0)
Monetary	5 (12.5)
Change management	14 (35.0)
Miscellaneous	19 (47.5)

EMR = Electronic Medical Record; Categories based on coding of open-ended questions; Multiple responses per-physician

4.6 Respondent Perceptions of EMR Systems

Table 8 details physician opinions regarding several general statements about EMR systems. Statements were rated on a Likert scale of 1 to 5, where 1 was strongly disagree and 5 was strongly agree. The two statements that physicians agreed or strongly agreed with had the highest level of agreement were "EMRs are a useful tool for physicians, such as when documenting patient information" (mean = 4.15) and "Physicians should use EMR systems" (mean = 4.02). It is also interesting to note that physicians disagreed that "EMRs will take away from doctor-patient interactions" (mean = 2.44).

Table 8: Physician opinions with general statements about EMR systems

General Statement	Mean (std deviation)
Physicians should use EMR systems	4.02 (0.92)
EMRs will improve the quality of care	3.87 (0.97)
EMRs are a useful tool for physicians, such as when documenting patient information	4.15 (0.80)
EMRs will take away from doctor-patient interactions	2.44 (1.02)
EMRs are more secure than paper records	3.20 (1.01)
EMRs are too expensive	3.39 (0.97)
EMRs will reduce medical errors	3.09 (1.06)
An EMR will increase physician workload	3.03 (1.09)
EMRs are more confidential than paper records	2.87 (0.97)

EMR = Electronic Medical Record; Statements were rated on a Likert scale of 1 to 5, where 1 was strongly disagree and 5 was strongly agree

4.7 Respondent Beliefs in EMRs Effect on the Practice of Health Care

Table 9 details physician opinions about their perception of the effect (beneficial or detrimental) of EMR systems on the practice of health care. Statements were rated on a Likert scale of 1 to 5, where 1 was highly detrimental and 5 was highly beneficial. The two statements that physicians felt were beneficial or highly beneficial to the practice of health care were "Clinicians' access to up-to-date knowledge" (mean = 4.20) and "Access to health care in remote or rural areas" (mean = 4.10).

Table 9: Physician opinions with the beneficial effect of EMR systems on the practice of health care

The effect that EMRs may have on medicine and health care in relation to...	Mean (std deviation)
Costs of health care	3.32 (0.88)
Quality of health care	3.86 (0.71)
Access to health care in remote or rural areas	4.10 (0.68)
Enjoyment of the practice of medicine	3.54 (0.84)
Personal and professional privacy	3.21 (0.84)
Doctor-Patient relationship	3.18 (0.71)
Clinicians' access to up-to-date knowledge	4.20 (0.64)
Patients' satisfaction with the quality of care they receive	3.50 (0.69)
Role of government in health care	3.14 (0.80)
The rapport between clinicians and patients	3.20 (0.71)

EMR = Electronic Medical Record; Statements were rated on a Likert scale of 1 to 5, where 1 was highly detrimental and 5 was highly beneficial

4.8 Respondent Perceptions Regarding the Costs of EMR Systems

Physicians were asked questions about the cost of implementing an EMR system and its monthly cost of maintenance, including questions on government subsidy. Table 10 details responses regarding set-up costs and Table 11 shows those responses related to monthly maintenance costs.

A large percent of physicians (41.9%) felt that the initial setup of an EMR system should cost between $1,000 and $4,999 per physician. Most (94.9%) felt the government should subsidize the initial setup cost. Almost half (48.2%) believed that 100% of the set-up costs should be covered by the government.

In relation to ongoing monthly maintenance, almost half (41.9%) of physicians responded that the monthly ongoing cost of using an EMR system should be less than $50. A large number (87.9%) felt that the government should subsidize the monthly maintenance fees. Almost half (47.0%) believed that the government should cover the whole of the monthly cost.

Table 10: Physician opinions regarding set up costs of EMR systems

Variable	n (%)
I believe that an affordable price per physician to set up an EMR is…	
< $1,000	95 (26.4)
$1,000 - $4,999	151 (41.9)
$5,000 - $9,999	69 (19.2)
$10,000 - $20,000	31 (8.6)
> $20,000	14 (3.9)
Do you believe the government should subsidize the cost of EMR installation?	
No	20 (5.1)
Yes	376 (94.9)
What percentage of the set up cost do you feel the government should cover?	
5%	0 (0.0)
10%	3 (0.8)
15%	4 (1.1)
25%	12 (3.4)
50%	101 (28.3)
75%	65 (18.2)
100%	172 (48.2)

EMR = Electronic Medical Record; Variables may add up to less than 409 due to missing data

Table 11: Physician opinions regarding ongoing costs of EMR systems

Variable	n (%)
I am willing to spend the following amount monthly for ongoing use of an EMR system…	
< $50	144 (41.9)
$50 - $99	81 (23.5)
$100 - $149	60 (17.4)
$150 - $200	45 (13.1)
> $200	14 (4.1)
Do you believe the government should subsidize the monthly cost of EMR usage?	
No	47 (12.1)
Yes	342 (87.9)
What percentage of the set up cost do you feel the government should cover?	
5%	1 (0.3)
10%	5 (1.5)
15%	1 (0.3)
25%	16 (4.8)
50%	107 (32.0)
75%	47 (14.1)
100%	157 (47.0)

EMR = Electronic Medical Record; Variables may add up to less than 409 due to missing data

4.9 Other Comments

At the end of the survey, respondents were provided with space to give comments on this study and questionnaire. A total 103 physicians (25.2%) provided a response to this question (Table 12). As shown in Table 12, the responses to this question were mostly positive in nature (65%), and were composed of comments along the lines of good, interesting, or valuable. Those commenting directly on the survey indicated both positive comments and suggestions for improving the survey. Positive comments on the survey were in the vein of respondents feeling that the survey length was acceptable, that the questions covered a comprehensive look at the topic. Those indicating a way to improve the survey suggested that the wording of certain questions favoured EMRs and their use, others indicated a wish for the survey to be available online, and others indicated a need to distinguish between hospital-based and community-based physicians, as well as their fee-for-service versus salaried funding.

Table 12: Physician opinions on this study and questionnaire

Category	n (%)
General comment – positive	67 (65.0)
General comment – negative	9 (8.7)
Comment on survey format	18(17.5)
Comment on cost	2 (1.9)
Comment on EMR - negative	2 (1.9)
Miscellaneous comments	5 (4.9)

EMR = electronic medical record; Categories based on coding of open-ended question

Chapter 5: Discussion and Conclusions

This study describes the characteristics, computer training and use, perceptions about EMR systems, and opinions on acceptable costs EMR systems of physicians in NL. This information has been shown in the literature to indicate which physicians are more likely to accept and use an EMR system and to help guide implementation plans.

5.1 Representativeness of the Sample

Survey response rate of 40.5% is considered reasonable for this study population. The NPS (2007), which surveyed all physicians in Canada, had a response rate of 32.1% using a mailed paper survey. Surveys of small subsets of physicians in NL had higher response rates of 50.0% (Gates, 2004) and 84.0% (MacEachern, 2009); these rates are thought to be higher due to the smaller size and specialized nature of these studies populations.

Respondents are representative of the physician population of NL with regards to gender but not speciality. The study sample under represented the proportion of family physicians while over representing the proportion of specialists. This difference could result in respondent bias. Since specialists in the province are generally located in hospital settings or clinics in large urban areas, they could have more knowledge of different information technologies and the use of computers in their practice of health care. This difference could also indicate that specialists have more interest in the topic of EMR systems. The response bias could be a reflection of survey respondent fatigue among family physicians, who may have received many surveys on this topic.

5.2 Current Use and Training with Computers

Eight out of ten physicians reported having a computer at home and at their place of work. The majority of physicians feel they have an average skill level using their computer; these skills were primarily obtained mostly through self-guided learning. These findings are similar to those found in the literature. Cork et al. (1998) reported that the respondents (full-time physician faculty members) to that study, self-rated their computer skills as average and that "self-guided learning" was the main type of training for computer skills. In the workplace, physicians' primarily use their computer to obtain patient test results and to review patient histories. Relatively few physicians use their computers to write sick notes, order prescriptions, order tests, or to refer patients. These findings suggest that computers are not well integrated into the practice of health care by physicians in NL and that they are used to passively receive and review information but not actively used to communicate with other physicians or resources.

5.3 Physician Knowledge and Use of EMR systems

The majority of physicians agreed with the provided definition of an EMR system (see section 2.2). Physicians who agreed with the definition felt that an EMR system would improve health care practice, while those who disagreed with the definition expressed a strong dislike of introducing computers into the health care process.

Less than half of the physicians indicated they had used an EMR system. This seems to be due to the general confusion with regards to the MediTech system and participants being unclear of the differences between EHR and EMR systems, with different

respondents indicating they had and had not used an EMR system but used MediTech. This difference in knowledge of EMR systems, and MediTech in particular, could be a result of the survey sample over representing the proportion of specialists for NL; since specialists generally work in hospitals they would have more knowledge of MediTech and have used the system more than family physicians in community practices and thus treat the system as an EMR.

5.3.1 Physician Perceptions of EMR Systems

The survey results indicate that physicians are in favour of the implementation and use of EMR systems in their practice of health care. There is a high level of agreement to statements such as: "Physicians should use EMR systems" and "EMRs are a useful tool for physicians...". These findings are similar to those found by Loomis et al. (2002), who surveyed active members of the Indiana Academy of Family Physicians (both users and non-users of EMR systems). Loomis et al. (2002) found that the majority of EMR users and non-users agreed that "physicians should computerize their medical records".

This generally positive view of EMR systems among physicians in this study was further expressed in the responses provided for the general open-ended question about EMRs, where physicians expressed overwhelmingly that EMRs would improve access to and the efficiency of care provided. These reasons echoed statements provided by the survey respondents in the Neville et al. (2007) study. Neville et al. (2007) conducted a study to assess the feasibility of implementing an EMR system in NL, the sample for this

study included all staff (physicians, licensed practical nurses, office staff, and residents) at four clinics in the St. John's area of NL.

While physicians perceived EMR systems positively, concerns were expressed over their use and implementation. These concerns matched those commonly expressed in the literature and were related to system costs (Boonstra & Broekhuis, 2010; Johnston et al., 2002; Loomis et al., 2002; Ludwick et al., 2010; Retchin, 1999; Simon et al., 2005; Terry et al., 2009; Wang et al., 2003), change management (Boonstra & Broekhuis, 2010; Clayton et al., 2005; Gadd & Penrod, 2001; Joos et al., 2006; Laerum et al., 2001; Loomis et al., 2002; Ludwick et al., 2010; Terry et al., 2009; Young, 1984), and technology concerns (Boonstra & Broekhuis, 2010; Johnston et al., 2002; Joos et al., 2006; Kaelber et al., 2005; Loomis et al., 2002; Ludwick et al., 2010; OECD, 2010; Retchin, 1999; Santiage et al., 2006; Terry et al., 2009; Young, 1984). Additionally, some physicians indicated that the personal traits of some (i.e. length of time practicing and age of physician) would be a barrier to the implementation and use of EMR systems. These findings are similar to results from Boonstra and Broekhuis (2010) and Joos et al. (2006), as well as other literature ("Physician use of EMRs", 2005; Ford et al., 2006; Miller et al., 2005; Simon et al., 2005).

5.3.2 Physician Beliefs Regarding EMRs Effect on the Practice of Health Care

The majority of physicians supported the move towards using an EMR system, as indicated by their responses to the open-ended questions system. They also indicated a need to move forwards with implementing a standard and interoperable EMR system for

NL, so that they could catch up and keep pace with the rest of Canada and other countries. Physicians perceived EMR systems as enabling them to access more up-to-date information and allow for improved access for remote and rural areas. Perceptions of improved access for remote and rural health care were also found by Cork et al. (1998).

Still as the results of this study and the literature demonstrate, the majority of benefits listed for using EMR systems are perceptions and more research is needed to establish actual benefits from the implementation of EMR systems. This is illustrated by Greiver et al. (2011) who studied the implementation of EMRs for specific services using pay-for-performance incentives in Ontario. Greiver et al. (2011) found that there was no significant change in the practice of health providers related to these services even with the features the EMR system provided such as reminders.

5.4 Physicians Perceptions of EMR Costs

Physicians overwhelmingly agreed that the costs of changing from paper, training themselves and their staff, along with hardware, maintenance, and support costs should be subsidized by government in some way. The OECD (2010) recently released a report that states that that subsidies or grants are necessary for start-up but does not influence the continued use of the EMR system and that financing policy needs to be put into place prior to system implementation. The report states that the adoption of EMR systems is more successful in countries where subsidies or grants are used to "insulate" physicians from any losses from up-front costs and potential decrease in productivity. Ludwick et al. (2010) found that different remuneration approaches were needed for EMR adoption

based on the physicians' work environment, and that training and in-house technical support may be more of an influence in EMR adoption that remuneration alone.

In this study, physicians believed that initial setup should cost a physician between $1000 and $4999, and that maintenance costs should be less than $50 a month. From the literature we can see that estimated costs of implementing an EMR system (in US $) range from $1,600 to $10,000 per physician for software costs alone (Brown, 2005; Wang et al., 2003). Loomis et al. found that users of EMRs felt that an affordable price per physicians for EMR set-up costs was $5000-$9999, while, non-users felt the price should be in the $1000-$4999 range. However in terms of monthly maintenance costs, Loomis et al. (2002) found that physicians felt the cost should be in the range of $100-149 a month, compared to the lower amount of $50 or less indicated by physicians in this study.

Cost appears to be the most important barrier to implementation and use of EMR systems in NL. Currently there are no subsidies for physicians to assist with the costs associated with the implementation and maintenance of EMR systems in NL. In the pilot study of EMR system implementation in NL (Neville et al., 2007), provincial and research funding were used to cover equipment and software costs. Still it was noted that physicians considered the time required to learn to use the system and the increase in time for patient visits as additional implementation costs, especially for fee-for-service physicians in the study (Neville et al., 2007). Future research should be conducted to look at potential reimbursement models and their efficacy for EMR implementation and use. These models should address the variety of fee models in the province and the differences associated with practice locations, including hospital or community based and rural-urban differences.

5.5 Study Strengths

To our knowledge, this study is the first in NL to gather information from physicians to build a baseline of information about physicians' computer knowledge and use, and their attitudes towards EMR systems and their use in clinical practice. This is also the first study in NL to assess physician perceptions of costs related to EMR systems.

The response rate for the study is considered quite good with respect to the study population and the specific nature of the topic. A self-administered mail-out survey was the preferred method of data collection, since it is relatively inexpensive and is the most efficient way to sample all physicians in NL.

5.6 Study Limitations

The study sample includes a slightly higher proportion of specialists than the actual physician population of NL. Findings from the study may over represent specialists' perceptions and experiences. For example, specialists generally work in hospital settings and urban areas, and may have had more exposure to institution information technology systems, such as MediTech.

A pilot test may have identified questions that were not clear in their context or wording to non-experts. In addition, the definition of EMR used should provide clearer references to local systems, such as MediTech, so that physicians have a better idea of the EMR systems referred to by the definition used in the study. Future studies should look at physician fee structures related to EMR implementation and use.

5.7 Conclusions

Understanding NL physicians' knowledge and perceptions of NL physicians concerning EMR systems is an essential step towards creating an appropriate implementation plan that will better serve both the government and health boards who wish to initiate use of the system. We found that most physicians make limited use of computers in their practice of health care, despite the majority having average or above average computer skills. Physicians generally accepted the given definition of an EMR system and perceived positive benefits related to the implementation of EMRs. However, costs for both implementing and maintaining an EMR system appear to be a considerable barrier to physician use and acceptance of EMRs. Further development of public policy to address physician concerns about physician borne costs related to EMR implementation are needed to support ongoing EMR implementation in the province.

5.8 Recommendations

Based on the findings of the study we recommend:

1. *EMR Education.* The NLMA, along with the NL government, should continue to educate NL physicians on the benefits to using EMR systems. In addition, they should start educating the public on the general benefits of EMR systems related to their care.
2. *Computer Training.* Training in the use of computers and specific EMR systems should be offered, potentially with continuing medical education

credit, to allow physicians to gain a higher level of skill and comfort when using computers.

3. *Costing.* Research into the areas of physician borne costs related to EMR implementation and use, including potential subsidy models, should be undertaken by the NLMA and the NL government.

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Appendices

Appendix A: Survey

Physician knowledge, perceptions, and attitudes towards Electronic Medical Record Systems: Newfoundland and Labrador

This is a study of Newfoundland and Labrador physicians' attitudes and perceptions of Electronic Medical Record (EMR) systems. The results of this study will help the NLMA and the government to design an appropriate implementation process for the province and develop strategies to address any physician concerns. Your answers are very important to us! Please complete and return the survey in the provided envelope.

Section A: Current usage of Computers

a. Do you:

Please check all that apply in both columns	**have a**	**use a**
Desktop computer at home		
Desktop computer at work		
Laptop		
Personal Digital Assistant (PDA)		
Other:_____		

b. How did you learn to use your computer? *(check all that apply)*

- ☐ None
- ☐ Formal course(s) in computer science or related field
- ☐ Formal medical school training in computers
- ☐ Formal workshops or conferences on computers for which I received CMA credit
- ☐ Formal workshops or conferences on computers for which I did not received CMA credit
- ☐ Self-guided learning about computers
- ☐ Other:_____

c. How would you rate your computer skills? (*please circle your answer)*

Very sophisticated	Sophisticated	Average	Unsophisticated	Very unsophisticated
1	2	3	4	5

d. How often do you use a **computer** to do the following tasks in your practice?

Please check the box that matches your response	**Never**	**Sometimes**	**Always**	**I don't perform this task**
Review patient history and/or record				
Communicate with colleagues				
Write sick notes				
Obtain advice on a specific patient's diagnosis or therapy				
Obtain the results of a patients test/procedure				
Order X-Ray, ultrasound or CT investigations				
Refer the patient to other departments or specialists				
Write prescriptions				
Other: _____				

Section B: Electronic Medical Records

a. Do you agree with the following definition of an Electronic Medical Record (EMR)?

> "...electronically stored information about an individual's lifetime health status and health care. It replaces the paper medical record and provides reminders and alerts, linkages with knowledge sources for decision support and data for outcomes research and improved management of health care delivery" *Institute of Medicine (1997)*

☐ Strongly Disagree ☐ Disagree ☐ Unsure ☐ Agree ☐ Strongly Agree

Why / Why not? _____

_____

_____

b. Have you ever used an Electronic Medical Record System? ☐ Yes ☐ No

c. What do you feel is the **biggest advantage** of an EMR system?

_____

_____

_____

d. What do you feel is the **biggest barrier** related to EMR systems?

_____

_____

_____

e. For each of the following general statements about EMRs, please rate the level of your agreement to these statements by circling the appropriate response.

Please circle the appropriate response	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Physicians should use EMR systems	1	2	3	4	5	N/A
EMRs will improve the quality of care	1	2	3	4	5	N/A
EMRs are a useful tool for physicians, such as when documenting patient information	1	2	3	4	5	N/A
EMRs will take away from doctor-patient interactions	1	2	3	4	5	N/A
EMRs are more secure than paper records	1	2	3	4	5	N/A
EMRs are too expensive	1	2	3	4	5	N/A
EMRs will reduce medical errors	1	2	3	4	5	N/A
An EMR will increase physician workload	1	2	3	4	5	N/A
EMRs are more confidential than paper records	1	2	3	4	5	N/A

f. Listed below are some effects that EMRs may have on medicine and health care. Please indicate whether you believe the effect will be beneficial or detrimental.

Please circle the appropriate response	Highly Detrimental	Detrimental	Neither	Beneficial	Highly beneficial	Don't Know
Costs of health care	1	2	3	4	5	N/A
Quality of health care	1	2	3	4	5	N/A
Access to health care in remote or rural areas	1	2	3	4	5	N/A
Enjoyment of the practice of medicine	1	2	3	4	5	N/A
Personal and professional privacy	1	2	3	4	5	N/A
Doctor – Patient relationship	1	2	3	4	5	N/A
Clinicians' access to up-to-date-knowledge	1	2	3	4	5	N/A
Patients' satisfaction with the quality of care they receive	1	2	3	4	5	N/A
Role of government in health care	1	2	3	4	5	N/A
The rapport between clinicians and patients	1	2	3	4	5	N/A

g. I believe that an affordable price per physician to **set up** an EMR system is:

- ☐ < $1,000
- ☐ 1,000 - $4,999
- ☐ $5,000 - $9,999
- ☐ $10,000 - $20,000
- ☐ > $20,000

h. Do you feel that government should subsidize the cost of installation? ☐ Yes ☐ No

If yes: How much do you believe the government should cover? *(please circle your answer)*

5 % 10 % 15% 25% 50% 75% 100 %

i. I am willing to spend the following amount monthly for **ongoing use** of an EMR:

- ☐ < $50
- ☐ $50 - $99
- ☐ $100 - $149
- ☐ $150 - $200
- ☐ > $200

j. Do you feel that government should subsidize the monthly costs of usage? ☐ Yes ☐ No

If yes: How much do you believe the government should cover? *(please circle your answer)*

5 % 10 % 15% 25% 50% 75% 100 %

Section C: Demographics

Please check the appropriate box for each question!

a. Age: ☐ <35 years old ☐ 35-50 years old ☐ >50 years old

b. You are: ☐ Male ☐ Female

c. Please describe your practice size:
☐ Solo ☐ Small group (2-6) ☐ Large group (>6) ☐ Hospital employee
☐ Other: _____

d. How many health care providers are there in your practice? _____
(e.g. physicians, nurses, social workers, psychologists, dieticians, etc.)

e. What is your current area of speciality (*Please check the one most applicable to your practice*):

☐ Anesthesiology	☐ Infectious disease	☐ Paediatrics
☐ Cardiology	☐ Laboratory medicine	☐ Psychiatry
☐ Critical care	☐ Nephrology	☐ Radiology
☐ Emergency medicine	☐ Neurology	☐ Rheumatology
☐ Endocrinology	☐ OB/GYN	☐ Surgery
☐ Family medicine	☐ Oncology	☐ Urology
☐ Gastroenterology	☐ Ophthalmology	☐ Other: _____
☐ General internal medicine	☐ Orthopaedics	

f. How many years have you been in practice? _____ years
(including internship, residency, and fellowship training)

g. What is the size of the community you practice in?
☐ < 1000 ☐ 1000 – 4999 ☐ 5000 – 10,000 ☐ > 10,000

Section D: Other Comments

a. Comments about EMRs in general.

_____

_____

_____

b. Comments on the move towards the use of EMRs in clinical practice.

_____

_____

_____

c. Comments on this survey and study.

_____

_____

_____

Thank you for taking the time to complete this survey!
If you have any other comments please include them on a separate sheet.

Appendix B: Survey Creation

The following table describes the questions used to create the survey (Appendix A) used in this study. Question source(s) are identified, modifications made from the source are listed and the relevant study objective is indicated.

Table 13: Survey question sources, modifications, and study objectives

Questionnaire Item	Source	Modifications Made	Study Objective
Section A: Current usage of Computers			
Do you have a desktop computer at home	Cork et al. 1998 Loomis et al. 2002		Current computer use
Do you have a desktop computer at work	Cork et al. 1998 Loomis et al. 2002		Current computer use
Do you have a laptop	Cork et al. 1998		Current computer use
Do you have a PDA	Loomis et al. 2002		Current computer use
How often do you use a computer to do			
Review patient history and/or record	Cork et al. 1998 Laerum et al. 2001 Laerum et al. 2004	The Laerum (2004) questions were modified to computer usage categories	Current computer use
Communicate with colleagues	Cork et al. 1998		Current computer use
Write sick notes	Laerum et al. 2001 Laerum et al. 2004		Current computer use
Answer questions about medical issues	Cork et al. 1998 Laerum et al. 2001 Laerum et al. 2004		Current computer use
Obtain the results of a patients test/procedure	Laerum et al. 2001 Laerum et al. 2004		Current computer use
Order X-Ray, ultrasound or CT investigations	Laerum et al. 2001 Laerum et al. 2004		Current computer use

Questionnaire Item	Source	Modifications Made	Study Objective
Refer the patient to other departments / specialists	Laerum et al. 2001 Laerum et al. 2004		Current computer use
Write prescriptions	Laerum et al. 2001 Laerum et al. 2004		Current computer use
What training or experience with computers have you had?	Cork et al. 1998		Current computer use
How would you rate your computer skills?	Cork et al. 1998 Laerum et al. 2001	Laerum survey - wording was changed	Current computer use
Section B: Electronic Medical Records			
Do you agree with the following definition of an EMR?	Simon et al. 2005	Some slight wording changes	EMR knowledge
Definition: why why/not	New		EMR knowledge
Have you ever used an EMR System?	New		Demographic
What do you feel is the biggest advantage to using an EMR system?	New		EMR knowledge
What do you feel is the biggest barrier to using an EMR system?	New		EMR knowledge
General statements about EMR systems			
Physicians should use EMR systems	Loomis et al. 2002	Modified from "Physicians should computerize their medical records"	EMR knowledge
EMRs will improve the quality of care	Loomis et al. 2002		EMR knowledge
EMRs are a useful tool for physicians, such as when documenting patient information	Loomis,GA. 2002	Added a descriptor so physicians could properly define "tool"	EMR knowledge
EMRs will take away from doctor-patient interactions	Cork et al. 1998 Kaelber et al.2005 Laerum et al. 2001	Cork – modified to EMR knowledge from computer	EMR knowledge

Questionnaire Item	Source	Modifications Made	Study Objective
EMRs are more secure than paper records	Loomis et al. 2002	Added "than paper records"	EMR knowledge
EMRs are too expensive	Cork et al. 1998 Kaelber et al.2005 Laerum et al. 2001 Loomis et al. 2002		EMR knowledge
EMRs will reduce medical errors	Loomis et al. 2002		EMR knowledge EMR knowledge
An EMR will increase physician workload	Cork et al. 1998 Kaelber et al.2005 Laerum et al. 2001		EMR knowledge
EMRs are more confidential than paper records	Loomis et al. 2002		EMR knowledge
EMR knowledges of EMRs on medicine and health care			
Costs of health care	Cork et al. 1998	Selected options and reworded options for NL content from the Cork survey	EMR knowledge
Quality of health care	Cork et al. 1998		EMR knowledge
Access to health care in remote or rural areas	Cork et al. 1998		EMR knowledge
Enjoyment of the practice of medicine	Cork et al. 1998		EMR knowledge
Personal and professional privacy	Cork et al. 1998		EMR knowledge EMR knowledge
Doctor – Patient relationship	Cork et al. 1998		EMR knowledge

Questionnaire Item	Source	Modifications Made	Study Objective
Clinicians' access to up-to-date-knowledge	Cork et al. 1998		EMR knowledge EMR knowledge
Patients' satisfaction with the quality of care they receive	Cork et al. 1998		EMR knowledge
Role of government in health care	Cork et al. 1998 Kaelber et al.2005 Laerum et al. 2001		EMR knowledge
The rapport between clinicians and patients	Cork et al. 1998 Kaelber et al.2005 Laerum et al. 2001		EMR knowledge
I believe that an affordable price per physician to set up an EMR system is	Loomis et al. 2002		Costing
Do you feel that government should subsidize the cost of installation?	New		Costing
If yes: How much do you believe the government should cover?	New		Costing
I am willing to spend the following amount monthly for ongoing use of an EMR:	Loomis et al. 2002		Costing
Do you feel that government should subsidize the monthly costs of usage?	New		Costing
If yes: How much do you believe the government should cover?	New		Costing
Section C: Demographics			
Age Category	Cork et al. 1998 Kaelber et al.2005 Laerum et al. 2001		Demographic
Gender	Cork et al. 1998 Kaelber et al.2005 Laerum et al. 2001 Loomis et al. 2002		Demographic

Questionnaire Item	Source	Modifications Made	Study Objective
Please describe you practice size:	Loomis et al. 2002	Removed the option of multi-disciplinary	Demographic
How many health care providers are there in your practice?	Simon et al. 2005		Demographic
What is your current area of specialty?	Cork et al. 1998	Did not included all specialty options	Demographic
How many years have you been in practice?	Kaelber et al.2005		Demographic
What is the size of the community you practice in?	Loomis et al. 2002 Simon et al. 2005 Laerum et al. 2001	Used commonly listed community sizes (from the Health Research Unit) instead of rural, urban classifications	Demographic
Comments about EMRs in general.	New		EMR knowledge
Comments on the move towards the use of EMRs in clinical practice.	New		EMR knowledge
Comments on this survey and study.	New		

Appendix C: Information Letters

A. Initial Letter

Faculty of Medicine
Memorial University of Newfoundland and Labrador

Description of the study

You are being invited to participate in a research study. The following is a brief description of the study and additional information you can use to decide if you would like to participate.

Introduction/Background: **This is a study of Newfoundland and Labrador physicians' attitudes towards and perceptions of Electronic Medical Record (EMR) systems. The main objectives are to establish a baseline of physicians' current level of computer skills, to assess physicians' perceived effects of EMR systems on health care practices and physicians' general attitudes towards EMRs.**

Your participation is very important to us in order to obtain the fullest and most accurate assessment of the objectives listed above. The results of this study will be made available to the Newfoundland and Labrador Medical Association and the government to design an implementation process for an EMR system for the province and develop strategies to address physician concerns.

Procedures: **You are being asked to complete the questionnaire and to return it in the provided envelope by September 28th. The questionnaire should take approximately 10 minutes to complete. This survey is anonymous and your name will not be printed in any report coming from this study.**

The questionnaire will have an identification number associated with it. This number will be assigned by a staff member of the e-Health Research Unit, and the Investigators in this project will not be able to link any physician to an identification number. This number will only be used for mail-out purposes.

Risks and Benefits of being in the study: **This study does not pose any risks to your professional status and responses will be kept confidential. There are no immediate benefits to participating in this study. This study has been approved by the Human Investigation Committee, the ethics board for Memorial University of Newfoundland and Labrador and is supported by the Newfoundland and Labrador Medical Association. Your consent to participate in this study is implied by the return of the completed survey.**

Questions: **If you have any questions concerning this study, you can talk with the investigator in charge of the project:**

Sara Heath, 746-0203
Email: sheath@mun.ca

Or you can talk to someone who is not involved with the study at all, but can advise you on your rights as a participant in a research study. This person can be reached through:

Office of the Human Investigation Committee (HIC) at 709-777-6974
Email: hic@mun.ca

Sincerely,

Dr. Gerard Farrell, Administrative Lead
e-Health Research Unit, MUN

Sara Heath, Principal Investigator

B. Follow-up Letter

Faculty of Medicine
Memorial University of Newfoundland and Labrador

Description of the study

You have been invited to take part in a research study. If you have already participated in this study and returned the questionnaire we thank you for your time and your response. If you have not yet completed this questionnaire we hope that you take the time to realize the importance of this study and that you will take the time to participate. The date to submit your survey has been extended to October 24th.

Introduction/Background: **This is a study of Newfoundland and Labrador physicians' attitudes towards and perceptions of Electronic Medical Record (EMR) systems. The main objectives are to establish a baseline of physicians' current level of computer skills, to assess physicians' perceived effects of EMR systems on health care practices and physicians' general attitudes towards EMRs.**

Your participation is very important to us in order to obtain the fullest and most accurate assessment of the objectives listed above. The results of this study will be made available to the Newfoundland and Labrador Medical Association and the government to design an implementation process for an EMR system for the province and develop strategies to address physician concerns.

Procedures: **You are being asked to complete the questionnaire and to return it in the provided envelope by October 24th. The questionnaire should take approximately 10 minutes to complete. This survey is anonymous and your name will not be printed in any report coming from this study.**

The questionnaire will have an identification number associated with it. This number will be assigned by a staff member of the e-Health Research Unit, and the Investigators in this project will not be able to link a physician to an identification number. This number will only be used for mail-out purposes.

Risks and Benefits of being in the study: **This study does not pose any risks to your professional status and responses will be kept confidential. There are no immediate benefits to participating in this study. This study has been approved by the Human Investigation Committee, the ethics board for Memorial University of Newfoundland and Labrador and is supported by the Newfoundland and Labrador Medical Association. Your consent to participate in this study is implied by the return of the completed survey.**

Questions: **If you have any questions concerning this study, you can talk with the investigator in charge of the project. That person is:**

Sara Heath, 746-0203
Email: sheath@mun.ca

Or you can talk to someone who is not involved with the study at all, but can advise you on your rights as a participant in a research study. This person can be reached through the Office of the Human Investigation Committee (HIC) at 709-777-6974 or Email: hic@mun.ca

Sincerely,

Dr. Gerard Farrell, Administrative Lead
e-Health Research Unit, MUN

Sara Heath, Principal Investigator

Appendix D: NLMA Letter of Support

NEWFOUNDLAND AND LABRADOR
MEDICAL ASSOCIATION

December 11, 2006

Ms. Sara-Lynn Heath
Division of Community Health and Humanities
Faculty of Medicine, HSC
Memorial University of Newfoundland
St. John's, NL, A1B 3V6

Dear Ms. Heath,

I am pleased to indicate the Newfoundland and Labrador Medical Association's (NLMA) support for the study *"Physician knowledge, perceptions, and attitudes towards Electronic Medical Record Systems: Newfoundland and Labrador"*. This research project will help to identify physicians' attitudes towards electronic medical record systems, and enable the NLMA to address physician concerns with future electronic medical record implementation processes.

I understand that this project will survey the physicians of Newfoundland and Labrador on topics related to their readiness and expectations towards an electronic medical record system. This study will expand on previous work done by the NLMA in this area. As discussed, the NLMA will offer the following support for the project: provide a mail list of active physicians in the province, publish information about the study and study results on our webpage and/or in our newsletter.

We believe this is an exciting project which will be very valuable for future implementation strategies of electronic medical record systems in the province of Newfoundland and Labrador.

Sincerely,

Robert Ritter
Executive Director

Appendix E: Responses and Missing Data for Specific Questions

The following tables give details to the number of respondents for each question. This includes information about the numbers of responses which fall in the following categories, "Don't know", "No Response", and "Invalid Response", where applicable. These responses were excluded from any analysis related to the questions.

Table 14: Number of respondents for general questions about EMR knowledge (Question E, Section B)

General Statement	Number responded n (%)	Don't know n (%)
Physicians should use EMR systems	406 (99.3)	3 (0.7)
EMRs will improve the quality of care	399 (97.6)	10 (2.4)
EMRs are a useful tool for physicians, such as when documenting patient information	405 (99.5)	2 (0.5)
EMRs will take away from doctor-patient interactions	399 (98.3)	7 (1.7)
EMRs are more secure than paper records	387 (95.6)	18 (4.4)
EMRs are too expensive	389 (95.3)	19 (4.7)
EMRs will reduce medical errors	387 (95.1)	20 (4.9)
An EMR will increase physician workload	395 (97.1)	12 (2.9)
EMRs are more confidential than paper records	384 (94.6)	22(5.4)

Table 15: Number of respondents for the EMR perception questions (Question F, Section B)

General Statement	Number responded n (%)	Don't know n (%)
Costs of health care	359 (89.3)	43 (10.7)
Quality of health care	394 (97.0)	12 (3.0)
Access to health care in remote or rural areas	387 (95.8)	17 (4.2)
Enjoyment of the practice of medicine	385 (94.8)	21 (5.2)
Personal and professional privacy	374 (92.1)	32 (7.9)
Doctor-Patient relationship	391 (96.5)	14 (3.5)
Clinicians' access to up-to-date knowledge	391 (97.0)	12 (3.0)
Patients' satisfaction with the quality of care they receive	374 (91.9)	33 (8.1)
Role of government in health care	351 (87.1)	52 (12.9)
The rapport between clinicians and patients	384 (95.0)	20 (5.0)

Table 16: Number of respondents for the EMR costing questions (Questions G-J Section B)

Questions	Number responded n (%)	No Response n (%)	Invalid Response n (%)
I believe that an affordable price per physician to set up an EMR is…	360 (88.0)	47 (11.5)	2 (0.5)
Government subsidy questions	396 (96.8)	12 (2.9)	1 (0.2)
Percentage of government subsidy	357 (90.2)	29 (7.3)	3 (0.8)
I am willing to spend the following amount monthly for ongoing use of an EMR system…	344 (84.1)	65 (15.9)	0 (0.0)
Government subsidy questions	389 (95.1)	20 (4.9)	0 (0.0)
Percentage of government subsidy	334 (85.9)	27 (6.9)	3 (0.8)

Appendix F: Survey Variables and Coding Scheme

The following table details the coding scheme for the collected survey data. Each question is listed, along with the questions text, variable name and coding used. All variables, except questions E and F in section B, are categorical data. Questions E and F in Section B are ordinal data (See Section 3.6).

Table 17: Survey variables and coding scheme

Question Text	Variable(s)	Question	Coding
Identification number	idnum		text entry
Section A: Current usage of Computers			
have a desktop computer at home	have_home	Question: a	1 – Yes 2 – No 9 – No Response
use a desktop computer at home	use_home	Question: a	1 – Yes 2 – No 3 – N/A 9 – No Response
have a desktop computer at work	have_work	Question: a	1 – Yes 2 – No 9 – No Response
use a desktop computer at work	use_work	Question: a	1 – Yes 2 – No 3 – N/A 9 – No Response
have a laptop	have_lap	Question: a	1 – Yes 2 – No 9 – No Response
use a laptop	use_lap	Question: a	1 – Yes 2 – No 3 – N/A 9 – No Response
have a pda device	have_pda	Question: a	1 – Yes 2 – No 9 – No Response
use a pda device	use_pda	Question: a	1 – Yes 2 – No 3 – N/A 9 – No Response

Question Text	Variable(s)	Question	Coding
how did you learn to use your computer?	learn_1 learn_2 learn_3 learn_4	Question: b	1 – none 2 – Formal course in computer science 3 – Formal medical school training 4 – Formal workshops: CMA credit 5 – Form workshop: no credit 6 – self-guided learning 7 – other 8 – N/A 9 – No Response
Other method of learning to use your computer	other_learn	Question: b	OPEN ENDED – text entry
How would you rate your computer skills	comp_skills	Question: c	1 – Very Sophisticated 2 – Sophisticated 3 – Average 4 – Unsophisticated 5 – Very Unsophisticated 8 – Invalid 9 – No Response
How often do you use the computer to: review pt history communicate write sick notes obtain advice obtain test results order tests refer patients write prescriptions	 practice_review practice_comm practice_sick practice_advice practice_results practice_order practice_refer practice_persc	Question: d	 1 – Never 2 – Sometimes 3 – Always 4 – I don't perform this task 8 – Invalid 9 – No Response
other use of computers in your practice	other_practice	Question: d	OPEN ENDED – text entry
How often do you use the computer to: other use	practice_other	Question: d	1 – Never 2 – Sometimes 3 – Always 4 – I don't perform this task 7 – N/A 8 – Invalid 9 – No Response

Question Text	Variable(s)	Question	Coding
Section B: Electronic Medical Records			
do you agree with the following definition of an EMR	definition	Question: a	1 – Strongly Disagree 2 – Disagree 3 – Unsure 4 – Agree 5 – Strongly Agree 8 – Invalid 9 – No Response
why/why not do you agree with the definition	definition_why	Question: a (why)	1 – Comment 2 – No Comment
have you ever used an EMR system	emr_use	Question: b	1 – Yes 2 – No 8 – Invalid 9 – No Response
General Statements physicians should use EMR systems EMRs will improve the Quality of care EMRs are a useful tool for physicians EMRs will take away from doctor-patient interactions EMRs are more secure than paper records EMRs are too expensive EMRs will reduce medical errors An EMR will increase physician workload EMRs are more confidential than paper	 gen_use gen_improve gen_tool gen_interact gen_secure gen_cost gen_errors gen_work gen_confid	Question: e	1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree 6 – Don't Know 8 – Invalid 9 – No Response

Question Text	Variable(s)	Question	Coding
Effect on health care		Question: f	
Costs of health care	eff_cost		
Quality of health care	eff_quality		
Access to health care in remote or rural areas	eff_access		
Enjoyment of the practice of medicine	eff_enjoy		1 – Highly Detrimental 2 – Detrimental 3 – Neither 4 – Beneficial 5 – Highly Beneficial 6 – Don't Know 8 – Invalid 9 – No Response
Personal and professional privacy	eff_privacy		
Doctor-Patient relations	eff_relation		
Clinicians' access to up-to-date knowledge	eff_know		
Patients' satisfaction with the quality of care they receive	eff_satisf		
Role of government in health care	eff_gov		
The rapport between clinicians and patients	eff_rapport		
I believe that an affordable price per physician to set up and EMR is	setup_cost	Question: g	1 – < $1,000 2 – $1,000-$4,999 3 – $5,000-$9,999 4 – $10,000-$20,000 5 – > $20,000 8 – Invalid 9 – No Response
Do you feel that government should subsidize the cost of installation	setup_gov	Question: h	1 – Yes 2 – No 8 – Invalid 9 – No Response

Question Text	Variable(s)	Question	Coding
How much do you believe the government should cover? (set up cost)	setup_pay	Question: h (if yes)	1 – 5% 2 – 10% 3 – 15% 4 –25% 5 – 50% 6 – 75% 7 – 100% 8 – N/A 9 – No Response 10 – Invalid
I am willing to spend the following amount monthly for ongoing use of an EMR	use_cost	Question: j	1 – < $50 2 – $50-$99 3 – $100-$149 4 – $150-$200 5 – > $200 8 – Invalid 9 – No Response
Do you feel that government should subsidize the monthly cost of usage	use_gov	Question: k	1 – Yes 2 – No 8 – Invalid 9 – No Response
How much do you believe the government should cover? (monthly use cost)	use_pay	Question: k (if yes)	1 – 5% 2 – 10% 3 – 15% 4 –25% 5 – 50% 6 – 75% 7 – 100% 8 – N/A 9 – No Response 10 – Invalid
Section C: Demographics			
Age category	age	Question: a	1 – < 35 years old 2 – 35-50 years old 3 – > 50 years old 8 – Invalid 9 – No Response
Gender	gender	Question: b	1 – Male 2 – Female 8 – Invalid 9 – No Response
Practice Size	group_cat	Condensed Practice_sz Question: c	1 – Solo or Small Group 2 – Large Group or Hospital or Other 9 – Missing

Question Text	Variable(s)	Question	Coding
What is your current area of speciality?	spec_cat	Condensed speciality Question: e	1 – Family Physician 2 – Specialist /Other 9 - Missing
how many years have you been in practice	practice_yr	Question: f	999 – No Response
what is the size of the community you practice in	community	Question: g	1 – < 1,000 2 – 1,000-4,900 3 – 5,000-10,000 4 – > 10,000 8 – Invalid 9 – No Response
Open ended questions			
comments about emrs in general	com_emr	Section: D Question: a	1 – Comment 2 – No Comment
comments on the move towards the use of EMRs in clinical practice	com_move	Section: D Question: b	1 – Comment 2 – No Comment
comments on this survey and study	com_survey	Section: D Question: c	1 – Comment 2 – No Comment
what do you feel is the biggest advantage of an EMR system	big_adv	Section: B Question: c	1 – Comment 2 – No Comment
OPEN ENDED coding of biggest advantage Question	advant_1 advant_2 advant_3	Section: B Question: c	1 – Improved Health Care (General/Features) 2 – Access / efficiency / legible / comprehensive 3- Cost savings 4 – Paperless 5 – Research 66 – N/A
what do you feel is the biggest barrier related to an EMR system	big_bar	Section: B Question: d	1 – Comment 2 – No Comment
OPEN ENDED coding of biggest barrier Question	barrier_1 barrier_2 barrier_3 barrier_4	Section: B Question: d	1 – Program and Change Management Challenges 2 – Technological Challenges 3- Data Challenges 4 – Funding and Human Resources Challenges 5 – Other 66 – N/A

Appendix G: Data Coding/Cleaning for Multiple Responses

The following paragraphs describe the coding/cleaning for these data, outside of the general coding scheme as advised by local experts.

Section A: Current uses of computers: For Question a, which asked if physicians had and/or used different types of computer technology. Here a common cleaning issue was the "have a..." portion of the variable was often left blank even when the respondent had indicated they used the technology; in this case the "have a..." was coded as yes to match the "use a..." response. For Question b, "What training or experience with computers have you had?" some responses indicated both "none" and a type of learning, in these cases the type of learning indicated was coded instead of the "none".

For Question c, "How would you rate your computer skills?" in the cases where "average" and a different level of skill were selected, the response was coded as the skill level and not as "average". For Question d, "How often do you use a computer to do the following tasks in your practice?" respondents sometimes selected "I don't perform this task" with "never" or "sometimes"; in this case the variable was coded as "I don't perform this task".

Section B: Electronic Medical Records: For Question a, "Do you agree with the following definition of an Electronic Medical Record?", respondents have selected "unsure" with another level of agreement and the variable was coded as "unsure". In cases where two levels of agreement were selected (i.e. disagree and agree), the variable was coded as "unsure", any other combinations of responses was coded as "invalid" removed from analysis.

For Question e, " For each of the following general statements about EMRs, please rate the level of your agreement to these statements by circling the appropriate response.", when respondents selected "disagree" with "neutral" or " disagree" with "agree" the response was coded as "neutral". In the same way, for Question f, "Listed below are some effects that EMRs may have on medicine and health care. Please indicate whether you believe the effect will be beneficial or detrimental.", if respondents selected "detrimental" and "beneficial" the response was coded as "neutral"

For the costing Questions, for the amount the government should cover, the higher of the selected percentages was coded. Some respondents wrote in a response of "none" or "$0", this was coded as less than $50.

Section C: Demographics: For Question c, "Describe your practice size", a number of respondents selected more than one response. A common selection were "hospital" with either of small group/large group/other(ER), in which case the variable was coded as hospital, as it was felt that the respondent was identifying working in a group within a hospital setting . For Question d, "How many health care providers are there in your practice?" the Question was excluded from analysis due to the many different ways that physicians responded to the open-ended Question.

Appendix H: Human Investigation Committee Approval Letter

Memorial
University of Newfoundland

Human Investigation Committee
Research and Graduate Studies
Faculty of Medicine
The Health Sciences Centre

February 15, 2007

Reference #07.02

Ms. Sara-Lynn Heath
C/o Dr. Doreen Neville
Division of Community Health & Humanities
2nd Floor, Faculty of Medicine
Memorial University

Dear Ms. Heath:

This will acknowledge your correspondence dated February 12, 2007, wherein you clarify issues for your research study entitled **"Physician knowledge, perceptions, and attitudes towards electronic medical record systems: Newfoundland and Labrador".**

At the meeting held on January 4, 2007, the initial review date of this study, the Human Investigation Committee (HIC) agreed that the response could be reviewed by the Co-Chairs and, if found acceptable, full approval of the study be granted.

The Co-Chairs of the HIC reviewed your correspondence, approved the revised consent form and, under the direction of the Committee, granted ***full approval*** of your research study. This will be reported to the full Human Investigation Committee, for their information at the meeting scheduled for March 1, 2007.

Full approval has been granted for one year. You will be contacted to complete the annual form update approximately 8 weeks before the approval will lapse on **January 4, 2008.** It is your responsibility to ensure that the renewal form is forwarded to the HIC office not less than 30 days prior to the renewal date for review and approval to continue the study. The annual renewal form can be downloaded from the HIC website http://www.med.mun.ca/hic/downloads/Annual%20Update%20Form.doc.

Modifications of the protocol/consent are not permitted without prior approval from the Human Investigation Committee. Implementing changes in the protocol/consent without HIC approval may result in the approval of your research study being revoked, necessitating cessation of all related research activity. Request for modification to the protocol/consent must be outlined on an

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amendment form (available on the HIC website) and submitted to the HIC for review.

For a hospital-based study, it is **your responsibility to seek the necessary approval from the Health Care Corporation of St. John's and/or other hospital boards as appropriate**.

This Research Ethics Board (the HIC) has reviewed and approved the application and consent form for the study which is to be conducted by you as the qualified investigator named above at the specified study site. This approval and the views of this Research Ethics Board have been documented in writing. In addition, please be advised that the Human Investigation Committee currently operates according to the Tri-Council Policy Statement and applicable laws and regulations. The membership of this research ethics board complies with the membership requirements for research ethics boards defined in Division 5 of the Food and Drug Regulations.

Notwithstanding the approval of the HIC, the primary responsibility for the ethical conduct of the investigation remains with you.

We wish you every success with your study.

Sincerely,

John D. Harnett, MD, FRCPC
Co-Chair
Human Investigation Committee

Richard S. Neuman, PhD
Co-Chair
Human Investigation Committee

JDH;RSN\jed

C Dr. C. Loomis, Vice-President (Research), MUN
Mr. W. Miller, Director of Planning & Research, Eastern Health